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MSTA

NEWSLETTER

Montana Science Teachers Association

Volume 7, No. 2 "Dedicated to quality science education" May 1988

### *Congratulations*

The following people have been chosen for the B.E.S.T. (Better Elementary Science Teachers) Montana state workshop: Barbara Adams, Kalispell; Barbara Arrowtop, Heart Butte; Lynette Betlach, Helena; Theron Bjerke, Savage; Bonnie Boggs, Fort Benton; Sue Britton, Missoula; Jeane Bruton, Missoula; Ruth Carlstrom, Fort Benton; Lois Champlin, Helena; J. Garth Cox, Polson; Mary Denning, Fort Shaw; Terry Divoky, West Glacier; Catherine Ferguson, Helena; Mary (Shelly) Fortune, Silver Bow; Brenda Freeman, Fort Benton; Linda Garberg, Whitefish; Kathie Gessaman, Great Falls; Barbara Gneiting, Melrose; Gary Goebel, Helena; Larry Gursky, Polson; Mark Halgren, Polson; Judi Harris, Simms; Margaret Haugland, Toston; Frank Hollowell, Melstone; Lisa Johnson, Hamilton; Jackie Kegel, Thompson Falls; Billy Lee, Winifred; Wallace Leider, Lodge Grass; Louellen McCarthy, Helena; Janet McGough, Livingston, Carroll McLean, Billings; Lorraine McNamer, Charlo; Peg Nelson, Bozeman; Beverly Philpott, Buffalo; Diane Rewerts, Libby; Patti Ross, Chinook; Valerie Samson, Kalispell; Peter Scherfig, Gallatin Gateway; Sandra Schumacher, Kalispell; Darlene Stoltz, Missoula; Larry Tjeltveit, Missoula; Susan Wallace, Kila; Annette Walmsley, Seeley Lake; Carla Wambach, Helena; Ralph Weiser III, Worden; Ethyl White, Rexford; Larry Wilderson, Miles City; Michael Williams, Harrison; Barbara Wilson, Miles City; Carolyn Winegart, Missoula.

Congratulations also to the alternates: Sally Blevins, Eureka; Kathryn Brenden, Heart Butte; Scott Graham, Ronan; Rick Hannula, Bozeman; Charley Karinen, Lewistown; Susan Rollins, Hardin; Mabel Running Fisher, Browning; David Spence, Ronan; Nancy Streitmater, Judith Gap; Connie Wining, Arlee.

## *CURRICULUM*

### Measuring a Root's Holding Strength

Soak 12 large seeds like lima beans in water overnight. With a very small drill or darning needle, make a hole through the center of each seed, being careful to avoid the embryo. Thread a 15 cm piece of nylon filament fishing line through the hole, and tie the thread into a loop at the ends. Plant each seed in a separate container of soil, NOT soft polling mix, leaving the filament loop outside the soil. Water as appropriate for growing seeds. After 3 or 4 days, attach the loop to a spring scale calibrated in grams. Tug gently on the scale until the first seed is pulled out of the soil. Repeat every other day until each seed has been pulled up, recording the force and examining the growth of the roots. You can also plant seeds against the sides of glass jars so as to see how much the root grows. Use these seeds to record root growth, not force.

*Elementary Schools Science Association Newsletter*

### Animal Taxonomy

This exercise can be done with any animal group. I use it at the beginning of the unit on arthropods.

Each team of students is given a set of twenty index cards. On one side is the name of an arthropod. On the other side is a list of a few of the animal's characteristics. (For example, the lobster card lists segmented body, stalked eyes, and red exoskeleton.) The team arranges the cards into groups based on similar characteristics. They write out a simple key for their groupings. Teams of students exchange their cards and keys to see if their directions are clear enough for others to follow.

After the lab exercise, the students compare their keys to the actual divisions of arthropod groups. In class discussion the students learn why some characteristics are more important than others in determining taxonomic classification.

The practice phase of this lesson includes using the arthropod card as flash cards to identify the animal and its distinguishing characteristics, as well as its taxonomic classification. Then students are given an unknown animal to classify by using a dichotomous key.

### Plant Taxonomy

Each team of two or three students is given a collection of twelve sample plants. I use plastic, silk, or paper flowers and plants that I have checked for realistic monocot and dicot characteristics. The students group the plants as they wish, keeping in mind that all plants in a group must have at least one characteristic in common. Next they write a description of the common characteristics for each of their

plant groups. Then they exchange their "key" and their plants with another team of students. Those students try to place the plants in the same groups as the "key" describes.

In the instruction phase, we discuss how the plants were grouped and the difficulties of writing and following the keys. The class is then given the actual characteristics of monocots and dicots. We also use a simple dichotomous key to classify a few plants.

*Illinois Science Teacher*

## *The Brown Box Exercise*

To stimulate indirect observation and deduction I use a series of boxes, all wrapped in brown paper, with various objects inside. The objective is to determine what is inside each box by the size, shape and weight of the box, the sounds the contents make, and other clues. Most people do very well at identifying the contents, or at least making reasonable guesses. Several of the boxes I use are described in Table 1.

**Table 1**
**Brown Boxes and Their Contents**

| Contents | Comments |
|---|---|
| Styrofoam "peanuts" (packing material) | Fairly easy. Many youth guess a breakfast cereal. |
| Water in a metal bottle | How do you know it's water and not honey? Is the bottle made of plastic, metal or glass? |
| Baby toy that rattles and squeeks. ("Box" is a brown cloth bag) | Can determine size, shape and hardness by feel. Most youth correctly guess "Bigbird." |
| Two wrenches | Metallic clank |
| Can of tennis balls | Tennis balls or soup can? |
| 12 dowels 1.57 x 20 cm (Box is 10x17x30 cm) | How long are the dowels? |
| Two toy cars taped back to back in a cylindrical box | The cars always roll down the tube but tumble if the tube is rolled. |
| Bell suspended in the center of a box | Jingle, cow or church bell? How could you tell if the box were soundproof? |

Initially I hand out the boxes and ask what the contents are. Usually a student will provide an answer. Typically I then ask a few questions designed to get the students to focus on why they chose that answer. One such exchange went something like this.

I gave a student a light-weight box which he promptly shook.

"Sugar Crisp."

"What makes you think so?"

"It sounds like Sugar Crisp when I shake it."

"How do you know that it is Sugar Crisp and not Fruit Loops.?"

"OK, it's a sugar-coated breakfast cereal."

And so on. (The box in question actually contains Styrofoam "peanuts," a packing material which sounds very much like breakfast cereal. Invariably someone will guess the correct contents.) The intent is to get the students to focus on exactly what information they have, and what can be concluded from it. After one or two such exchanges, the students begin to make more critical observations on their own and will often provide their evidence for a given conclusion.

In this exercise students are, subconsciously perhaps, applying the scientific method. Usually they enter the process by experimentation (shaking and listening), then propose a hypothesis, test and refine it. After the first few boxes have been passed around and their contents identified, I point out the method being used implicitly and alter the exercise to expose the use of the scientific method. In terms of the scientific method, I introduce a hypothesis and ask how we can test it, rather than performing the test first and then trying to interpret it. In terms of this demonstration, I tell a class what the box might contain and ask how we can tell if it does. For example, "This box contains twelve 5/8 inch dowels of the same length. How can we tell how long they are?" In each case the answer may be deduced by simple manipulation of the box and listening. Once the class has proposed an appropriate method for answering the question, I give them the box, to apply their method and answer the question.

If the two demonstrations are being done together, this is a good place to return to the blue bottle exercise (Stout, 1986) using a series of leading questions to elicit the appropriate observations and conclusions. A constructive conclusion to this indirect observation exercise is a discussion of indirect observation methods commonly used in science. There are numerous examples from all areas of science. In geology, for example, a study of the rock formations and fossil record of an area can indicate past climatic conditions. You and your students will be able to provide many other examples.

**Acknowledgement**

I would like to thank Karen Murphy, in whose classes this and several other demonstrations have been tested, and Dr. Wilbert Hutton who informed me of the prior history of this exercise.

*Iowa Science Teachers Journal/Autumn 1987*

## Creative and Effective Teaching of Science

**Summer 1988, Western Montana College**

A workshop entitled "Creative and Effective Teaching of Science" will again be held this summer at Western Montana College. It is designed for teachers of grades 1-9 and will be held from June 20th to July 15th.

**Workshop Outline**

The focus of the workshop will be on designing and putting into action a creative and effective science curriculum. Materials to support the curriculum will be viewed, designed, made and ordered during the course of the workshop.

Activities to support the goal of the workshop include:

*Lectures and discussions on the role and purpose of science education in today's world.

*Lectures and discussion on current thought and trends in the teaching of science.

*Lectures on recent advances in both the knowledge and application of science.

*Opportunity to discuss and develop the aims and rationale for an integrated and balanced science curriculum.

*Exposure to a wide range of science materials, including the interactive video disc programs.

*Opportunity to build and develop demonstration apparatus.

*Opportunity to adapt and develop sets of laboratory activities which will enable students to have hands-on experiences in science.

**Workshop Information**

Place: Western Montana College, Dillon, MT 59725

Time: Monday, June 20 to Friday, July 15. The workshop hours will be 8:30 a.m. to 4:30 p.m. Mondays through Fridays.

Credit: The workshop may be taken for 6 semester hours graduate credit. There will be a registration fee of $40 for those taking the workshop for credit. (Normally it would cost $246.50 to register for 6 credit hours.)

**Apparatus Stipend**

An apparatus stipend will be available to most participants for the purchase of apparatus or other materials in order to make it possible to put the ideas discussed and developed during the workshop into action.

**More Information**

For more information and application forms, write to Dr. John M. Rogan, Western Montana College, or contact by phone at 1-800-WMC-MONT or 683-7132.

## *FREE OR NEARLY FREE RESOURCES*

### Reviews

Audubon Video Asks "What's the Limit?"

The National Audubon Society has released a 23-minute video, **What's The Limit?**, that delves into the interrelationships between human population growth, environmental degradation, resource depletion, habitat destruction and the ethical considerations for the future. The fast-paced video is accompanied by a discussion guide, Where **Do We Go From Here?**, that offers suggestions for group activities.

The videotape and discussion guide are available for $25 from the National Audubon Society. Preview copies are also available from your local Audubon chapter or National Audubon Society, Population Program, 801 Pennsylvania Avenue, SE, Washington, DC 20003. Identify yourself as a high school teacher and you will also receive a special teacher's guide.

**New From the World Bank**

The World Bank has published two new poster kits, **Life Expectancy at Birth** and **Population Growth Rate**, to help bring the developing world into the classroom. Each kit contains a colorful map of the world (24" x 36") with data on 148 countries, easy-to-read text, and three charts illustrating key concepts; six color photographs that depict the people behind the statistics; and a comprehensive teaching guide with a full range of student activities.

Each kit is available for a special introductory price of $6 from World Bank Publications, Department 0552, Washington, DC 20073-0552.

**3-2-1 Contact in Third Season**

PBS shows a half-hour program that focuses upon science and technology each day. Aimed at 8-12 year olds, the show is organized around a different theme each week. The producers try to provoke the natural curiosity of the child. They think about their show using such terms as *on location, natural entertainment, involvement in scientific method,* and *critical thinking.*

For a schedule, write Children's Television Workshop, 1 Lincoln Plaza, New York, NY 10023.

**Science Projects**

"Science Project—A Modular Approach," by Mike Farmer, a science teacher, is a step-by-step manual for students and teachers on how to develop successful science projects. In 52 pages, it gives suggestions and hints that range from picking a topic to setting up an exhibit. The author emphasizes careful planning, consistency, the use of computers and the scientific method. The appendices include science project ideas, an animal certification form, a list of useful computer software, sample data tables, science fair regulations, and a bibliography. For a copy, mail $5.50 to Applied Educational Technology, P.O. Box 193, Tigerville, SC 29688.

Lifetime Learning Systems, Inc., 79 Sanford St., Fairfield, CT 06430 has materials for teaching teenage sexuality—called "Straight Talk."

**Agency for Instructional Technology Presents**

*Challenge*

A new video series for 5th and 6th grade students that takes viewers around the nation and into the solar system. Sixteen 15-minute programs cover the physical, earth, and life sciences, space and technology.

*Women in Science*

A new eight-part video series designed to encourage junior high, high school and early college-age women to consider science careers and to build the background needed for a science major.

Further description plus details about preview, purchase and leasing arrangements can be obtained from the Agency for Instructional Technology, Box A, Bloomington, IN 47402 or by calling (800) 457-4509.

*New Jersey Teachers' Association*

## *MSTA Elections This October*

This fall during the October general meeting, the members of the MSTA will elect a president-elect, a secretary and a treasurer to serve for the next two years. Every year members are elected to the board of directors either from the odd-numbered regions or the even-numbered regions. This year directors will be elected from the even-numbered regions, namely: Region II which includes Blaine, Chouteau, Fergus, Glacier, Judith Basin, Hill, Liberty, Pondera, Teton and Toole counties; Region IV which includes Beaverhead, Broadwater, Deer Lodge, Gallatin, Jefferson, Meagher, Madison, Lewis & Clark, Park, Powell and Silver Bow counties; and Region VI which includes Carter, Custer, Dawson, Fallon, Powder River, Prairie, Richland, Rosebud and Wibaux counties.

The elections committee is accepting nominations for this fall's election. If you wish to nominate someone, or if you are interested in serving the MSTA either as an officer or member of the board of directors, please submit a letter of nomination before **July 10, 1988.** Nominations should be sent to Richard Micheletto at 706 Polaris Way, Missoula, MT 59803. Other members of the nominations committee are Kristy Bick, Russ Hartford, Linda Robinson and Steve Schumacher.

Additional nominations for officers or directors will be accepted from the floor during the general meeting at the convention in October.

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## Summer Workshops Coming to Glacier

The Glacier Institute is sponsoring 14 summer field classes in Glacier National Park which include:

**Roadside Geology,** *An Ancient Story Unfolds* (June 20-22 and August 1-3)

**Nature Close-ups,** *Photography in Glacier* (June 23-24)

**Glacier's Grizzlies,** *An Introduction to the Grizzly* (June 25-26 and July 30-31)

**North Fork Country,** *Water, Wilderness and Wildlife* (June 27-29)

**Return of the Wolf,** *Accommodating a Predator* (July 5-7)

**Nature in Your Classoom,** *Using Nature as a Teacher* (July 9-10)

**People of the Mountain World,** *The Old Days and the Old Ways* (July 13-15)

**Alpine Wildflowers,** *The Highest and the Heartiest* (July 16-17)

**Mountains, Valleys and Glaciers,** *Exploring a Billion Years of Earth's History* (July 18-22)

**Mountain Landscape Images,** *Photography in Glacier* (July 23-24)

**Glacier's Life Zones,** *Forests, Tundra and Prairie* (July 25-29)

**Advanced Photography,** *Wilderness Through Your Lens* (August 4-7)

**Glacier's Wildlife,** *Mountain Goats to Squirrels* (August 8-12)

**Glacier on Foot,** *Walking Softly* (August 13-16)

For more information write The Glacier Institute, P.O. Box 1457B, Kalispell, MT 59903 or call Flathead Valley Community College, (406) 752-5222.

## *DEADLINES AND AWARDS*

The deadline for presentation proposals for the NSTA National Convention in Seattle, Washington (to be held April 6-9, 1989) is June 1, 1988. Contact Bill Schmitt, NSTA Convention Chairperson, Pacific Science Center, 200 Second Avenue North, Seattle, WA 98109.

**National Center for Excellence in Education**

**You Are Invited to Participate In:**

International Mathematics and Science Institutes for talented high school students;

Conference and workshops focused on the development of concrete steps to improve the quality of mathematics and science education in the United States.

The National Center for Excellence in Education (NCEE) was founded by a group of leading American scientists and business executives who wish to improve the quality of mathematics and science education in the United States. NCEE is unique among American schools in having secured commitments from many eminent scientists, among whom are Nobel Laureates and members of the National Academy of Sciences, to participate in our educational programs for high school students and teachers. NCEE projects are closely coordinated with the National Science Teachers Association and the National Council of Teachers of Mathematics.

Located on the campuses of Long Island University (LIU) at Southampton, Long Island; University of California at Los Angeles (UCLA), and a university of the South of France, NCEE's International Summer Institutes offer students distinct academic settings for stimulating intellectual challenges as well as opportunities for many cultural and recreational activities.

For further information please call (202) 364-0200 or write NCEE, 4301 Connecticut Ave., NW, Suite 131, Washington, DC 20008.

**Science Scholarships Offered**

The Armed Forces Communications and Electronics Association will award $250, $100 and $50 scholarships to the senior high school students who submit the best projects by May 28, 1988. Projects may pertain to any subject, but each should demonstrate some communication and/or electronics application. To submit projects or receive further information contact Herb Anderson, Scholarship Chairman, Big Sky Chapter, Armed Forces Communications and Electronics Association, 120 Lonesome Pine Drive, Raynesford, MT 59469, 738-4345.

## Scholarships for Aviation/Aerospace Teachers

The Montana Aeronautics Division is sponsoring six college Aviation/Aerospace Teacher Workshops. Scholarships valued at $100, which help defray tuition and provide for an actual flight experience, will be awarded to up to 30 Montana school teachers at each workshop. The workshops will be conducted at various times between June 13 and July 1, 1988.

For more information or to register, contact any of the following:

University of Montana, Continuing Education Department (workshops in Missoula and Great Falls)

Montana State University, Continuing Education Department at Bozeman

Eastern Montana College, Continuing Education Department at Billings

Dawson County Community College, Registrar, Glendive

Carroll College, Registrar, Helena

Montana Aeronautics Division, P.O. Box 5178, Helena, MT 59604.

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## Department of Honors
## Honors Research Program
## 1988

**Argonne National Laboratory**
**Winner:** Gwen Dee Gray, Capital High School, Helena
**Alternate:** Charles Thomas Gibson, Flathead High School, Kalispell

**Lawrence Berkeley Laboratory**
**Winner:** Shane E. Arthur, Belgrade High School, Belgrade
**Alternate:** Kurt D. Lindsay, Flathead High School, Kalispell

**Brookhaven National Laboratory**
**Winner:** Sheldon Richards, Sentinel High School, Missoula
**Alternate:** George Shimada, Sentinel High School, Missoula

**Fermi National Laboratory**
**Winner:** Gary Steingas, Sentinel High School, Missoula
**Alternate:** Dale Apple, Geraldine High School, Geraldine

**Oak Ridge National Laboratory**
**Winner:** Angela Ibara, Helena High School, Helena
**Alternate:** Todd Sperry, Sentinel High School, Missoula

**National Science Camp**
**Winners:** Cari Michelle Karns, C. M. Russell High School, Great Falls
Ryan Lee Hawk, Sentinel High School, Missoula

## Storms, Good or Bad?

*by Robert Fortune*

Foolish question, really, but I've been surprised at the number of youngsters who damn storms outright. It's a bit like having Day, but let's not have Night. It might be interesting to take a vote from your crew.

Once you arrive at a percentage (the sharper kids will figure it's a trick question and vote 'good', thus spoiling our opinion sample), try taking it a step further. Are storms necessary or unnecessary? This question carries a lighter emotional load. Many may vote 'necessary' for the same reason that school has recess and tests. Good and bad, but it's all school—maybe the same applies to the weather.

Well, you might ask, what would the world be like without any storms at all? If you're talking to the groups I've talked to you should get some wild feedback. Treasure every observation. Maybe jot them down on the board.

If you have a globe, it would be helpful for the next stage. Failing that, draw a circle (all right, so it's an oblate spheroid) on the board, slash an equator across it, and hang a flag on the North Pole.

Where, you ask, is it almost always warm? So you identify the tropical zone. Everyone will have the next answer: where is it almost always cold? Now you can put a couple of C's for cold on the north and south poles.

Every day the poles suffer a net loss. They lose more heat than they gain. Remembering that this is a world with no storms, let's move ahead in time—say two or three months. The air over the poles is getting colder every day. Today it's minus 100 C. Eskimos are moving south.

The tropical zone now works the other way around. It gains more heat than it loses. Honolulu is unbearable. Beautiful tropical fish are dying. A few weeks later, it's much, much worse. The next day, Mother Nature says, "That's enough!" She wants to keep everything in balance. Once her decision is made, there is a storm to end all storms. KA-BOOM! The huge domes of frigid air at both poles plunge to the equator. There is, of course, no one left to discuss what happened.

And that's why our wonderfully balanced world has storms. Each and every storm has its job to do—drawing cold air from the North, warm air from the South and mixing them. The energy that was just sitting around with nothing to do (potential) is turned into wind and waves and swaying trees and falling rain (kinetic) and Nature smiles, happy to be doing her thing.

There are some gaping holes in this super-simplistic scenario, but if you're nine or ten, you may just welcome the next storm with a touch of respect.

## ACTIVITY IDEAS

To help your students see how population growth affects our global environment, our lifestyles, and our day-to-day activities, ask them each to bring in a newspaper from home. Have your students go through their newspapers to see how many population-related articles they can identify.

Ask them to cut the articles out and tape them to a sheet of paper. On the back of the paper, have them briefly describe how population growth is relevant to the article they clipped, and whether the article covered a local, state, national, international or global issue. Afterwards, students can report their findings to the rest of the class.

**Follow-up:**

Have students write an editorial about an article that was particularly meaningful to them. They can then submit their editorials to the school newspaper, or write a letter to the editor of the publication the article appeared in.

### Density Demonstration

Demonstrate increasing population density in your own classroom. Each day, limit students' activities to a portion of the classroom. For example, on day one allow students to use only ¾ of the classroom. On the following day, permit movement in only one half of the classroom, and so on. Continue to restrict the space available until there is only one square meter of space per student.

Ask students to react to the situation. What are the benefits, problems and concerns with this arrangement? Discuss the implications for the current population growth rate, which would cause the population to double in a little over 40 years.

### Radiation

*Barbara Banister*
*Northwest Institute Science Education*
*Portland State University*
*Portland, OR*

One of the three ways thermal energy is transferred from one substance to another is **radiation.**

If you sit a short distance from a fireplace, you take in heat and feel warm. But you did not touch the fireplace, and convection currents did not pass you. Energy reached you in the form of radiant energy. The heat you feel results from radiation. Radiant energy from the fire moves through space in waves. Like sunshine, the waves of radiant energy stream out from a source in all directions—they radiate.

Two versions of the same experiment will show radiation: finger to a flame and radiation tester.

Light a candle. Hold your finger next to the flame. Bring it as close as it is comfortable and use a ruler to measure approximately how close your finger was to the flame. Notice that you feel the heat of the flame even though you are not touching it (conduction) and your finger is not above it (convection). Hold your finger above the flame and notice that you are not able to bring it as close to the flame because convection is more efficient.

The same experiment done in a more quantitative way is the radiation tester. Repeat the experiment, except use wooden matches. Bring them next to the flame without touching it and they will ignite. Since they are not touching the flame or above it, they must have received heat through radiation. Bring them down to the flame from above and you will see that instead of being less than a half inch from the side of the flame, you can only bring them less than three inches from the flame.

Use the idea of radiation to explain the following: What difference does having a black or white car make on a hot day? (dark colors absorb slightly more radiant energy than light colors) Why do people wear light colored clothes in summer? Why can't people sit close to a roaring fire? Why do you have to be careful looking down at a casserole you are uncovering but not looking at it sideways?

### Take a Hike!

*Bob Riddle*
*Lakeview Museum Planetarium*
*1125 W. Lake Avenue*
*Peoria, IL 61614*

During lessons on space the discussion eventually gets around to the size of our solar system. Typically some type of model is employed to demonstrate the wide range of distance between the various members of the solar system. However, even with the use of models the students very often do not really understand or appreciate the vast distances the models portray.

So what should be done? Why not take a walk with your students out through the solar system? Simply set up a scale model of the solar system on the school playground, as described below, and start walking.

The size of the scale model that you use will in part be determined by the size of the playground, and also on how far you really want to walk. Table 1 shows scale distances for the planets based on the earth's distance to the sun set as one unit. By using a scale like this there is much more flexibility in how the model is stepped off. And, depending on the ages of your students, you might even have them work out a suitable scale to use.

**Table 1**

Relative Distances of the Planets as Compared to Earth

| Planet | Distance |
|---|---|
| Mercury | 0.40 |
| Venus | 0.75 |
| Earth | 1.00 |
| Mars | 1.50 |
| Asteroids | 2.33 |
| Jupiter | 5.50 |
| Saturn | 9.50 |
| Uranus | 19.20 |
| Neptune | 30.00 |
| Pluto | 39.40 |

For younger students this activity could be done in the gymnasium. Make it like the 'Mother May I' game, where the game caller could call on the planets (played by the students) to move the correct number of steps from the sun. The correct number of steps would place them along the appropriate orbital path around the sun. Use the idea of 'baby' and 'giant' steps, with a giant step being equal to an astronomical unit—earth's average distance from the sun. A baby step would be approximately one-third of an astronomical unit. This would place Mercury about 1 baby step from the sun, and Venus about 2 baby steps. At this scale the farthest planet, Pluto, would be around 40 steps from the sun.

On a slightly larger scale, and one that clearly shows the tremendous distances between planets, is a model based on one step being equal to 10 million miles. This would place earth 9 steps from the sun; Jupiter, at 5.5 times the earth-sun distance, would be around 50 steps; and Pluto, at 39.4 times the earth-sun distance, 355 steps from the sun.

To set up your walk-thru model assign the students to be the various members of our solar sytem. Send them out one at a time, starting with Mercury, so that the group can appreciate the ever increasing distances. Besides the planets, students could be used to represent the asteroids, comets and even the larger satellites of the planets.

Once the model is set up discuss with the students the significance of the activity. Our solar system is quite large in terms of planet sizes, or the distance between us and the sun. However, as the students will notice, there is lots of empty space in space. Consider this untitled poem by Ralph Waldo Emerson as you talk about the vast expanses of 'outer' space.

Atom from atom yawns as far
As moon from Earth, or star to star.

All of the objects in our solar system are in motion around the sun or a planet. The extra students that you might have can be used to represent these objects. A popular one is Halley's Comet. The student can trace out the path taken by this famous comet as it passed by us last year. Another popular object is the Voyager satellite. Launch this student from earth orbit and travel outwards towards Neptune. Let the student follow the same path that Voyager did, as it swung around Jupiter towards Saturn, and then on to Uranus. By the way, the satellite is scheduled for an encounter with Neptune in August of 1989.

It is always interesting, when doing this kind of scale modeling, to wonder about the bigger picture. Certainly we live within a large 'neighborhood', but how do we compare with other things in the universe. If the space in our solar system is virtually empty what is it like beyond our solar system.

The nearest star beyond Sol (our star) is part of the Alpha Centauri multiple-star system. For reference, our star is by itself, while many stars have companions, thus are referred to as multiple-star systems. This star system is approximately 4.0 light years from us, or about 24 trillion miles. At a scale of one step equal to an astronomical unit (93 million miles) Alpha Centauri would be 258,065 steps away. Some hike!

By marking each student's site around the model with signs on stakes driven in the ground, you will be able to take the hike with the whole class. Blend imagination with facts as the hike progresses. Have your students try to picture climatic conditions on the different planets. How about warmth, is Pluto as cold as Mercury is hot? Think about how much darker it must be on the outer planets as the distance from the sun increases. What would the sun look like as it moves across a planet's sky?

One of the neatest things to watch is the look of amazement and excitement that comes over a child's face as he or she discovers something new! Taking an imaginary hike around our solar system is certainly one way to see this excitement. So take a hike!

## *Canyon Ferry Limnological Institute*

*Co-Directors: Gil and Marilyn Alexander*

**Good News for Teachers!**

EESA Title II funds from the Office of Public Instruction will reimburse $200 of the workshop fee per participant for the Ed. 595 Field Methods in Science for Elementary Teachers workshop. To reserve your space in the workshop you must send in your $50 deposit and your Application-Survey Form soon.

**In Summary:** The total cost of the workshop is $400 as itemized below:

$200 paid by OPI
$200 paid by applicants (includes $35 for credits and the remainder of the workshop fee)

$35 of the total $400 workshop fee will be used to pay for the 4 quarter hours of continuing education graduate credit through the University of Montana. This $35 must not come from OPI funds. It is part of the fee paid by each individual participant.

**Mail Application-Survey Form to:** Canyon Ferry Limnological Institute, Gil & Marilyn Alexander, Directors, 504 Dearborn, Helena, MT 59601.

The workshop is advertised statewide and is limited to the first 20 applicants who apply by sending their Application-Survey Form and $50 deposit, **non-refundable after May 30, 1988.** The remaining $200 participant portion of the fee is due to the directors by MAY 30, 1988.

## Convention Photogate Workshop

MSAAPT, MSTA and OPI will present an inservice workday during the fall convention, October 20, 1988. The workshops will provide training to physics and physical science teachers in the use of computer interfacing. Participants will construct three photogate systems from Vernier software kits. The remainder of the workshop will involve implementation of the photogates in the classroom and exploring four or five exercises utilizing them. Only 24 participants will be allowed, so early registration will be important. All participants will be required to furnish their own computer (Apple IIe, Commodore or IBM). The cost of the workshop will be donated to the participants as will the photogate hardware and software and manuals.

**WATCH FOR THE PROGRAM ANNOUNCEMENTS THIS FALL!**

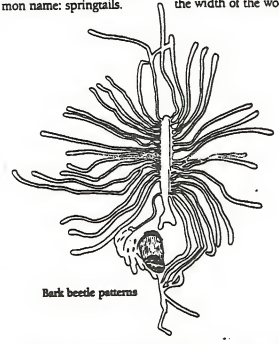
# SNUG AS A BUG FOR WINTER

Blackberry knot gall

As autumn fades and days get shorter, our thoughts turn to extra blankets, insulation, and antifreeze. Insects, lying dormant as eggs, larvae, pupae, or even adults, must also find ways to keep cozy in winter's icy grip.

Why don't we see many insects in the winter? Insects are cold blooded (**ectothermic**) which means their body temperatures are the same as the air around them. Warm-blooded (**endothermic**) animals, like humans, maintain their body temperature with the heat created by internal metabolic processes. In the winter many insects are "frozen stiff." Other insects use various strategies to avoid winter conditions that would be deadly.

Our activities in winter often uncover many hidden insects. Chopping firewood can expose the larvae of longhorn woodboring beetles that tunnel into heartwood. The larval longhorns, and metallic woodborers, also etch meandering grooves just under the bark. Tiny bark beetles engrave their own beautiful, species-specific design, the insect equivalent of graffiti. Ice fisherman can find bait in the form of stonefly and mayfly nymphs, still active under the insulating windows of ice. Other aquatic insects bury themselves in lake bottom sediment and await the spring thaw. Cross-country skiers may find insects out on the snow. Groups of tiny "snow fleas" look like patches of pepper. They bounce along on built-in pogo-sticks, spring-like appendages that give them their other common name: springtails.



Bark beetle patterns

The bare branches of trees may be draped with the debris of old tent caterpillar webs, or adorned with the abandoned paper palaces of yellowjackets. Nature's tinsel and ornaments also include plant galls. The tumor-like swellings on stems are the plant's growth reaction to invasion by a wasp, fly, or aphid. Inside, the larval insect, or insects, finds a bounty of food in a warm, safe home.

Many a moth spends the winter as a pupa, the resting stage between caterpillar and adult. Most species seek shelter underground, or in leaf litter, but the pupae of giant silkmoths are wrapped in packages of silk, sometimes two layers thick, designed to trap a layer of insulating air inside the cocoon. The silken sacks of bagworm moths look like little pine cones, suspended from twigs like Christmas stockings. The female moth never really grows out of the larval stage, and her eggs overwinter in her cocoon. Other moths, including the woollybear, winterize as caterpillars. Supposedly, one can tell the severity of the approaching winter by the width of the woollybear's black bands. Some butterflies hibernate as adults. The mourning cloak and related tortoiseshell butterflies hide in stumps and other shelters. The Monarch butterfly attempts to elude the cold altogether by migrating (see *Biologue* Vol.1, Number 2).

Whether an insect passes the winter as egg, larva, pupa, or adult, it is usually in a state of arrested development called "**diapause.**" In this condition, the insect does not feed or grow, and its metabolism slows. This inactivity leaves the creature vulnerable to freezing, so many insects produce antifreeze in the form of alcoholic compounds, glycerol, or related chemicals. Other insects actively excrete water. This prevents the development of damaging, lethal ice crystals in the insects' cells.

It is the shortening length of daylight that cuases insects to prepare for diapause. This phenomenon is called "**photoperiodism,**" and it dictates the life cycles and most daily activities of insects. A certain period of chilling may be necessary before an insect's diapause ends and development resumes, but otherwise, lengthening periods of daylight re-awaken the slumbering creature in the spring.

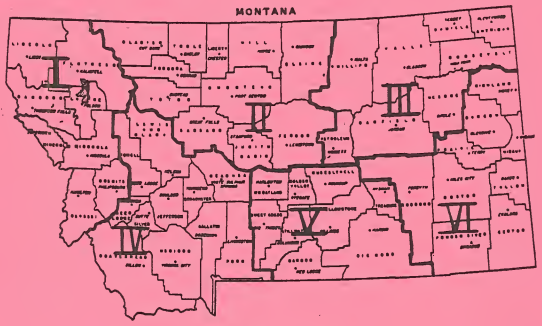
Considering how ubiquitous insects are, it is not surprising that they have discovered so many ways to survive harsh conditions. It may prove useful to study them further so we, too, can be snug as a bug in a rug in winter!

*—Eric Eaton is a freelance writer, artist, and naturalist living in Portland, Oregon.*

Silkmoth cocoon

## ATTENTION NEWSLETTER CONTRIBUTORS

Due to the travels of Doris Simonis, the new acting editor of the *MSTA Newsletter* is Judy Bazler. The co-editor is Amy Rusk. They may be reached at the University of Montana, School of Education, Missoula, MT 59812, (243-2378). Please send future articles and/or ideas to Judy or Amy until further notice.

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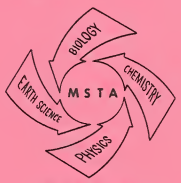
MSTA will help the individual participate in determining the destiny of science education in Montana. The organization serves as a vehicle for educators from all professions to exert positive influences on young people. Many important decisions concerning the scope and direction of science education will be strongly influenced by our organization.

The MSTA goals are to increase public awareness, interest and support of science education in Montana.

**Montana Science Teachers Association**

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